REMARKS

Claims 1-2, 4, 6-13, 15-17 and 19-25 are pending in the application. Claims 4, 6-13, 15, 17, and 19-20 stand allowed. (Cancelled Claim 5 is listed in the office action as being allowed, but was cancelled earlier. Claim 20 was allowed in the previous office action and is not discussed in the current office action.) Claims 1-2, 16, and 21-25 stand rejected. Claims 1 and 24 were cancelled. Claims 2, 16, 20-22, and 25 were amended. Claims 26-27 were added.

AMENDMENT OF CLAIM 20

Previously allowed Claim 20 was amended grammatically--an incorrect period was replaced with a semicolon.

DOUBLE PATENTING OBJECTION CLAIMS 1 AND 22

The office action indicated that should claim 1 be found allowable, claim 22 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. Claim 1 has been cancelled.

CLAIM REJECTIONS - 35 USC 102

Claims 1 and 22-24 were rejected under 35 U.S.C. 102(b) as being anticipated by R.T. Whitaker, J. Gregor, P.F. Chen, University of Tennessee, "Indoor Scene Reconstruction from Sets of Noisy Range Images", 1999, IEEE Second International Conference on 3-D Imaging and Modeling. The rejection stated:

> "With regard to claim 1, 'renowned institution' discloses a method for deriving a 3-D panorama from a plurality of images of a scene generated by a range imaging camera that produces ambiguities in range information (see the first paragraph of the 'Introduction': The reference describes deriving a 3-D model of an 'entire scene' (i.e. a panorama). The reference further describes that the images are 'laser range images' or 'LADAR data'. The applicant's disclosure (see paragraph [0027], inter alia) explains that the claimed range imaging camera that produces the range information is a laser radar. Accordingly, the reference anticipates this limitation.
>
> "'Renowned institution' further discloses acquiring a plurality of adjacent images of the scene, said adjacent images each having a known capture position defining a known spatial relation between said adjacent images, wherein there is an overlap region between the adjacent

images and at least some of the adjacent images are range images, said range images each having relative range values, said range images differing by said known spatial relation and an unknown relative range difference (see Figure 4a-b in conjunction with the reference's description of determining camera pose: The reference describes two embodiments. One in which a pose estimate is unavailable at the time of image capture, and another where a pose estimate is available at the time of image capture (this is discussed on the left side of the 2nd page of the reference). This second embodiment meets the claimed limitation because we have a known spatial relation (i.e. the approximate pose estimate), but our range difference (i.e. the range distance) is unknown until the system comes up with an estimate.).

"'Renowned institution' further discloses estimating a relative image difference between adjacent range images to provide an estimated constant offset between the adjacent images; and optimizing said estimated constant offset to provide an optimized constant offset (page 1, col. 2, final paragraph, the reference describes determining a distance between views. The reference futher elaborates on the view registration (or pose determination, see page 1, column 2, the first two lines of the second paragraph) method and the plane offsets (page 4, column 2) by defining variables w1 and w2 which are plane offsets. This shows a constant offset between adjacent range images as required by the claim. The above cited passage also shows an initial estimate of range differences which is subsequently optimized by a singular value decomposition operation to make the estimate more robust. This is in accord with applicant's own disclosure, which teaches using singular value decomposition for optimization of range estimates (applicant's disclosure paragraph [0034]).

"Regarding claim 22, 'renowned institution' discloses that the optimization process includes several computations (page 4, column 2). The reference further discloses that the process is performed on a computer (page 7, column 2). Thus, the optimization is automatic.

"Regarding claims 23 and 24, 'renowned institution' discloses that the estimation of the range difference uses a spatial relation

between the two images (see 'renowned institution' page 4: As was previously explained, the reference describes using spatial relation estimates in the estimate of the range difference. The spatial relation is a pose estimate mentioned previously in the paper.)."

Claim 1 was canceled. Claim 22 has been amended to state:

22. A method for deriving a three-dimensional panorama from a plurality of images of a scene generated by a range imaging camera of the type that produces ambiguities in range information, said method comprising the steps of:

acquiring a plurality of image bundles of the scene, said image bundles having capture positions differing by camera rotation about a Y-axis (vertical axis), wherein there is an inter-overlap region and known spatial relation between adjacent said image bundles, each said image bundle having an intensity image and three or more phase shift range images each having a different phase shift;

calculating range images from each of said image bundles, said range images each having three dimensional relative range values, adjacent said range images differing by a known spatial relation defined by respective said known capture positions and differing by an unknown relative range difference;

estimating said relative range difference between adjacent said range images to provide an estimated constant offset between the adjacent images;

automatically optimizing said estimated constant offset to provide an optimized constant offset; and

deriving a three-dimensional panorama from said range images and said optimized constant offset.

Claim 22 is supported by the application as filed, notably the original claims and at page 9, line 3 to page 10, line 24.

Claim 22 requires:

"acquiring a plurality of image bundles of the scene, said image bundles having capture positions differing by camera rotation about a Y-axis (vertical axis), wherein there is an inter-overlap region and known spatial relation between adjacent said image bundles".

This requirement is like similar language in the allowed Claim 4.

Claim 22 is also allowable as requiring the calculation of range images, each having three dimensional relative range values; adjacent range images differing by a known spatial relation and by an unknown relative range difference. The relative range difference is estimated and the result is optimized. The rejection argues for a second embodiment in the 'renowned institution' reference to meet the features of Claim 22. The rejection states:

> "The reference describes two embodiments. One in which a pose estimate is unavailable at the time of image capture, and another where a pose estimate is available at the time of image capture (this is discussed on the left side of the 2nd page of the reference). This second embodiment meets the claimed limitation because we have a known spatial relation (i.e. the approximate pose estimate), but our range difference (i.e. the range distance) is unknown until the system comes up with an estimate.)."

The proposed "second embodiment" cannot be understood from the rejection and a review of the "renowned institution" reference.

The left side of the 2nd page of the "renowned institution" reference has an inital incomplete paragraph discussing prior art pose determination methods, a full paragraph addressing approaches when a pose estimate is unavailable, and a final incomplete paragraph addressing prior art reconstruction methods. The latter two paragraphs do not match the subject matter of the proposed "second embodiment". The final incomplete paragraph is directed to reconstruction. The full paragraph relates to a pose estimate being unavailable:

> "Sometimes an approximate pose estimate is not available ... users can select a larger number of point correspondences--a time-consuming task and thus an undue burden. To address this problem, we propose a plane-based approach to view registration." (This "plane-based approach" is referred to in the Abstract of the "renowned institution" reference and is discussed in sections 2-5 of the "renowned institution" reference.)

The paragraph beginning on the right side of page 1 and continuing onto page 2 is limited to prior art directed to pose determination and registration. That paragraph is silent as to the "plane-based approach", disclosed in sections 2-5 of the "renowned institution" reference. No disclosure has been found elsewhere in

the "renowned institution" reference that the "plane-based approach" could have a "second embodiment" encompassing a technique in which an approximate pose estimate is available. The discussion in sections 2-5 is limited to a method, in which a pose estimate is unavailable at the time of image capture. For example, 'renowned institution' is limited to the "first embodiment" in section "3.1 Solving for Relative Pose":

> "This section shows the derivation of the equations needed for computing the camera pose directly from pairs of plane surface normals and offsets. Let $(\mathbf{n}_{1i},\omega_{1i})$ and $(\mathbf{n}_{2i},\omega_{2i})$ refer to a pair of corresponding planes. The problem is then to determine rotation matrix **R** and translation vector **t** such that if a point **p** lies a distance d from the plane $(\mathbf{n}_{1i},\omega_{1i})$ then point **q** = **Rp** + **t** is guaranteed to lie the same distance from the plane $(\mathbf{n}_{2i},\omega_{2i})$." (emphasis added; Section 3.1 includes page 4, column 2, which is relied upon by the rejection)

The emphasized language shows that this is an embodiment, in which a pose estimate is unavailable, since both the rotation matrix R and translation vector t are unknown. Section 3.1, thus, does not support the "second embodiment". The "renowned institution" reference fails to disclose all of the features of Claim 22. Even if the rejection had been made under 35 U.S.C. 103, the rejection would fail. The rejection is, in effect, arguing for a combination of the prior art and the "plane-based approach", disclosed in sections 2-5 of the "renowned institution" reference, without specifying the features of that combination and without identifying any motivation on the part of one of skill in the art to make that combination. See the discussion below of MPEP 2143 and 2143.01.

Claim 22 also requires image bundles. Claim 22 states:

> "acquiring a plurality of image bundles of the scene, said image bundles each having a known capture position, said capture positions differing by rotation about a common axis, each said image bundle having an intensity image and three or more phase shift range images each having a different phase shift".

Each image bundle of an intensity image and three or more phase images has a known capture position. The "renowned institution" reference does not disclose this feature.

Claim 23 is allowable as depending from Claim 22.

Claim 24 was cancelled.

CLAIM REJECTIONS - 35 USC 103

Claim 16 stands rejected under 35 U.S.C. 103(a) as being unpatentable over 'renowned institution'. The rejection stated:

"The arguments as to the relevance of 'renowned institution' as applied above are incorporated herein.

"'Renowned institution' further discloses deriving a 3D panorama from said range images and said optimized constant offset. This was discussed above with respect to the preamble of claim 1. As was stated, the 'entire scene' is analogous to the claimed 'panorama'. These two terms are definitionally equivalent (see Websters dictionary).

"'Renowned institution' further discloses providing offset data for the range images (page 1, column 2, final paragraph: The reference describes determining 'distances between views'. This is analogous to providing offset data as recited in the claim.) in order to recover corrected relative scene spatial information (page 1, column2, lines 4-7: The reference describes registering separate viewpoints and then integrating those viewpoints. This is analogous to recovering the relative scene spatial information. Furthermore, the second paragraph of the right column of page 2 describes a smoothing preprocessing operation is performed before all of the other processes. Smoothing qualifies as a type of 'correction'; therefore the reference also meets the claimed limitation of 'corrected relative scene spatial information.').

"The renowned institution' further discloses applying this offset data to correct for ambiguities in the relative ranges of the range images, thereby providing corrected range images. As was stated in the paragraph above, the 'renowned institution' discloses determining range differences between adjacent range images. These offsets are analogous to the ambiguities recited in the claim (also see page 2, column 1, final paragraph: this passage makes explicit mention of the ambiguities associated with the range images). The passage cited in the above paragraph shows how the range differences are used in the determination of a translation, which aligns, registers, or fits these images together, thereby providing corrected range images.

"'Renowned institution' inherently discloses a computer program product because a computer performing a process is disclosed at page 7.

"Regarding the additional limitation of "automatically providing offset data": 'renowned institution' does not anticipate this limitation because it requires user input. However, 'renowned institution' does expressly state that "Our ultimate goal is a totally automated system, and to this end we have designed the system to rely on user input only for the scan-to-scan plane correspondences, which we hope to automate in future implementations". It would have been obvious to one reasonably skilled in the art at the time of the invention to follow the suggestion of the 'renowned institution' and totally automate the existing system. Such a modification would have allowed for a system that could be executed without the added cost of user interaction."

Claim 16 was amended to state:

16 (previously presented). A computer program product for deriving a three-dimensional panorama from a plurality of images of a scene generated by a range imaging camera of the type that produces ambiguities in range information, said computer program product comprising: a computer readable storage medium having a computer program stored thereon for performing the steps of:

(a) accessing a plurality of adjacent images of the scene, said adjacent images having capture positions differing by camera rotation about a Y-axis (vertical axis), wherein there is an overlap region and a known spatial relation between said adjacent images, and at least some of the adjacent images are range images, said range images each having relative range values, said range images differing by said known spatial relation and an unknown relative range difference;

(b) automatically providing offset data for the range images in order to recover corrected relative scene spatial information, wherein the step of providing offset data further comprises:

(i) estimating said relative range difference between the adjacent range images to provide an estimated constant offset;

(ii) optimizing said estimated constant offset to provide an optimized constant offset;

(iii) applying the optimized constant offset to at least one of adjacent range images to correct for ambiguities in the relative ranges of the range images, thereby providing corrected range images; and

(c) deriving a three-dimensional panorama from the corrected range images.

Claim 16 is supported by the application as filed, notably the original claims.

Claim 16 requires:

"accessing a plurality of adjacent images of the scene, said adjacent images having capture positions differing by camera rotation about a Y-axis (vertical axis), wherein there is an overlap region and a known spatial relation between said adjacent images, and at least some of the adjacent images are range images,"

This requirement is like similar to language in allowed Claim 4 and is also allowable on grounds discussed above in relation to Claim 22. The rejection relies upon page 2, column 1 of the 'renowned institution' reference. As noted in relation to Claim 22, there is no teaching or suggestion in the 'renowned institution' reference to modify the "plane-based approach", disclosed in sections 2-5 of the "renowned institution" reference using the prior art described in page 2, column 1 of the "renowned institution" reference into the "second embodiment" proposed by the rejection.

Claim 16 also requires

"(b) automatically providing offset data for the range images in order to recover corrected relative scene spatial information, wherein the step of providing offset data further comprises:

"(i) estimating said relative range difference between the adjacent range images to provide an estimated constant offset;

"(ii) optimizing said estimated constant offset to provide an optimized constant offset;

"(iii) applying the optimized constant offset to at least one of adjacent range images to correct for ambiguities in the relative ranges of the range images, thereby providing corrected range images;"

The rejection relies upon a statement in the "renowned institution" reference, which states:

> "Our ultimate goal is a totally automated system, and to this end we have designed the system to rely on user input only for the scan-to-scan plane correspondences, which we hope to automate in future implementations". (The "renowned institution", section 3)

The emphasized language indicates that the "ultimate goal" is not a teaching, but a wish. The rejection fails to establish a prima facie case of obviousness. The MPEP states:

> "2143 Basic Requirements of a Prima Facie Case of Obviousness
>
> "To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.
>
> "The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)."

The hopes or wishes of the author of a reference do not present a reasonable expectation of success, since those hopes or wishes, by definition, cannot be accomplished within the teachings of the reference by one of skill in the art (the author of the reference). In relation to this point, the MPEP further states:

> '"In determining the propriety of the Patent Office case for obviousness in the first instance, it is necessary to ascertain whether or not the reference teachings would appear to be sufficient for one of ordinary skill in the relevant art having the reference before him to make the proposed substitution, combination, or other modification." In re Linter, 458 F.2d 1013, 1016, 173 USPQ 560, 562 (CCPA 1972).' (MPEP 2143.01)

A hope or wish does not allow one of ordinary skill in the relevant art having the reference before him to make the proposed substitution, combination, or other modification.

Claims 2 and 21 stand rejected under 35 U.S.C. 103(a) as being unpatenable over the combination of the 'renowned institution' and Hsieh et al. (USPN 6, 011,558). Claim 2 is allowable as depending from allowed Claim 20. Claim 21 is allowable as depending from Claim 22.

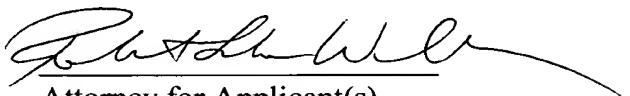
Claim 25 stands rejected under 35 U.S.C. 103(a) as being unpatentable over 'renowned institution' and further in view of well known prior art (official notice). Claim 25 is allowable as depending from Claim 22.

Added Claims 26 and 27 have language from Claims 4 and 20, respectively, and are allowable on the same basis.

It is believed that these changes now make the claims clear and definite and, if there are any problems with these changes, Applicants' attorney would appreciate a telephone call.

In view of the foregoing, it is believed none of the references, taken singly or in combination, disclose the claimed invention. Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

Respectfully submitted,



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